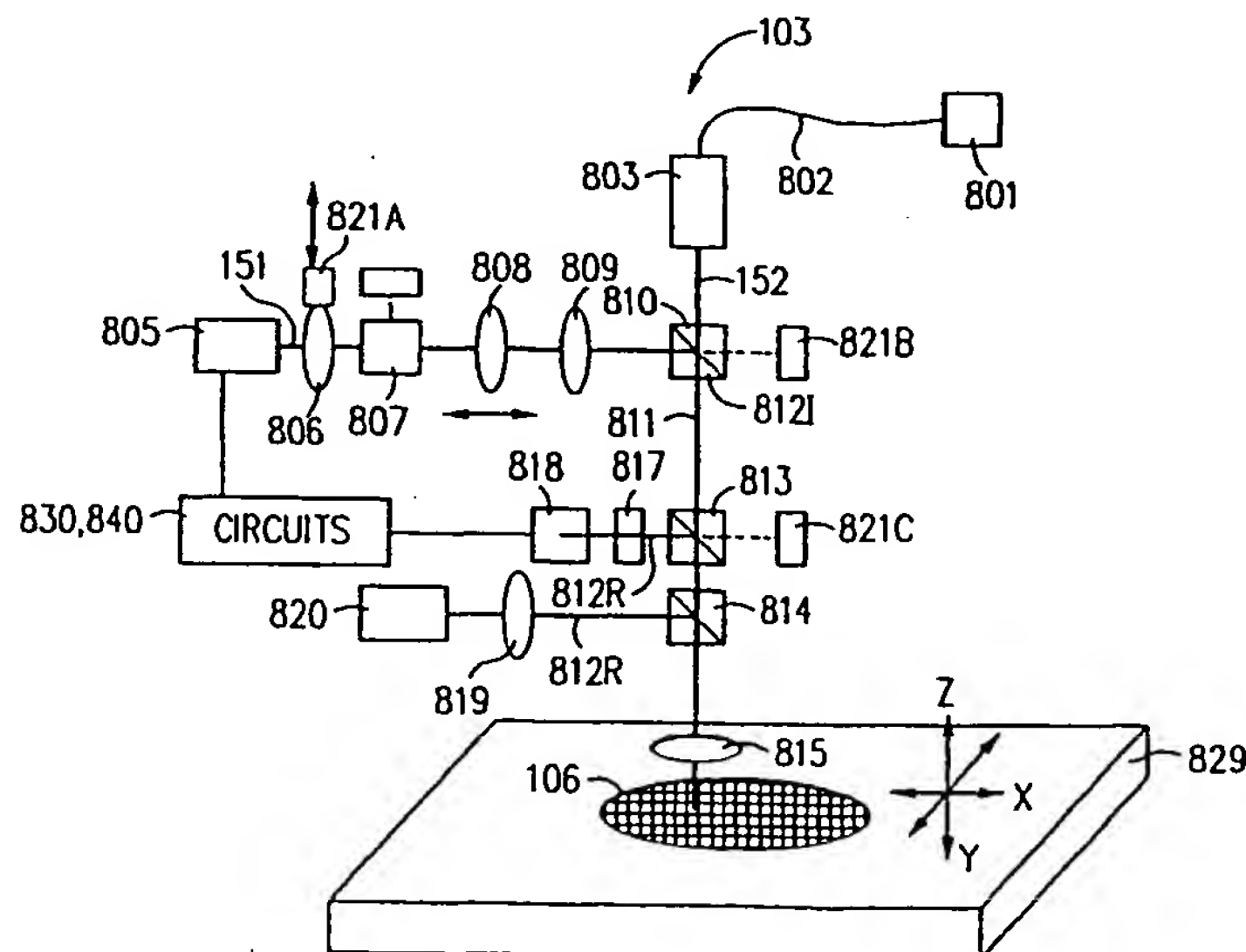




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>G01R 31/26, G01N 21/41</b>		<b>A1</b>	(11) International Publication Number: <b>WO 99/64880</b>
			(43) International Publication Date: 16 December 1999 (16.12.99)
(21) International Application Number: <b>PCT/US99/13084</b>		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: <b>9 June 1999 (09.06.99)</b>			
(30) Priority Data: <b>09/095,804 10 June 1998 (10.06.98) US</b>			
(71) Applicant: <b>BOXER CROSS INCORPORATED [US/US]; 978 Hamilton Court, Menlo Park, CA 94025 (US).</b>			
(72) Inventors: <b>BORDEN, Peter, G.; 118 Seville Way, San Mateo, CA 94402 (US). NIJMEIJER, Regina, G.; 555 Walker Drive #203, Mountain View, CA 94043 (US). LI, Jiping; 511 Central Avenue #0, Mountain View, CA 94043 (US).</b>			
(74) Agents: <b>SURYADEVARA, Omkar, K. et al.; Skjerven, Morrill, MacPherson, Franklin &amp; Friel LLP, Suite 700, 25 Metro Drive, San Jose, CA 95110 (US).</b>			
		<b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: SEMICONDUCTOR WAFER EVALUATING APPARATUS AND METHOD



## (57) Abstract

An apparatus and method uses diffusive modulation (without generating a wave of carriers) for measuring a material property (such as any one or more of: mobility, doping, and lifetime) that is used in evaluating a semiconductor wafer. The measurements are carried out in a small area, for use on wafers (106) having patterns for integrated circuit dice. The measurements are based on measurement of reflectance, for example as a function of carrier concentration. In one implementation, the semiconductor wafer (106) is illuminated with two beams (151, 152), one with photon energy above the bandgap energy of the semiconductor, and another with photon energy near or below the bandgap. The diameters of the two beams relative to one another are varied to extract additional information about the semiconductor material, for use in measuring, e.g. lifetime.

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US99/13084

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G01R 31/26; G01N 21/41  
US CL : 324/765; 356/432, 445

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 324/765; 356/432, 445

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
U.S. PTO APS: S CHARGE CARRIERS AND SEMICONDUCTOR AND FIRST AND SECOND AND FREQUENCY AND LASER

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,211,488 A (KLEINKNECHT) 08 JULY 1980 (08.07.80) SEE ENTIRE DOCUMENT.	1-63
A	US 4,273,421 A (GURTLER) 16 JUNE 1981 (16.06.81) SEE ENTIRE DOCUMENT	1-63
A	US 4,579,463 A (ROSENCWAIG ET AL) 01 APRIL 1986 (01.04.86) SEE ENTIRE DOCUMENT	1-63
A	US 4,854,710 A (OPSAL ET AL) 08 AUGUST 1989 (08.08.89) SEE ENTIRE DOCUMENT	1-63
A	US 4,952,063 A (OPSAL ET AL) 28 AUGUST 1990 (28.08.90) SEE ENTIRE DOCUMENT	1-63
A	US 5,379,109 A (GASKILL ET AL) 03 JANUARY 1995 (03.01.95)	1-63



Further documents are listed in the continuation of Box C.



See patent family annex.

Special categories of cited documents:	
*A* document defining the general state of the art which is not considered to be of particular relevance	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*E* earlier document published on or after the international filing date	*X* document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*O* document referring to an oral disclosure, use, exhibition or other means	*A* document member of the same patent family
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

21 SEPTEMBER 1999

Date of mailing of the international search report

28 OCT 1999

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

ERNEST F. KARLSEN

Telephone No. (703) 305-4700